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made more striking by contrast with the frequently used economy, which has the same reason for appearing as oeconomy.

While words of adverse criticism seem necessary here and there, one may write volumes of praise. WARMING'S *Plantensamfund* will be for all time the great ecological classic, and the English volume now before us is the most important ecological work in any language. It is at the same time an old book and a new, a translation of the masterpiece of 1895 and a compendium of the ecological thought of 1909. WARMING has been contributing to ecology for more than forty years, and is the undisputed Nestor of the subject, but unlike many a Nestor, WARMING incarnates the ambitions and plasticity of youth. It will be pleasing to American ecologists to see the remarkable recognition accorded to their work in this new volume. The German edition of 1896 contained but one American title, though a half-dozen more might have been included. Now there are 600 titles in all, almost exactly twice the number published in 1896, and it is not unfair to say that half of the ecological work thus far accomplished is represented by the added titles of the last thirteen years. It will be flattering to Americans to note that 115 of the 300 new titles represent American contributions, a record that measures up well with the bare half-dozen that might have been named in the original 300. The new edition has ample footnote references, adding inestimably to the service of the work. The absence of illustrations will be a source of disappointment to many, but it accounts in large part for the extremely low price of the volume, a price that will insure a sale that has been accorded to no ecological work in the English language.—HENRY C. COWLES.

Experimental morphology

Although experimental morphology received its original impetus from observations on plants, during the last few years there has been a great dearth of botanical contributions to this field as compared with what the zoologists have done. It is partly with the hope of stimulating anew botanical exploration in this fascinating field that GOEBEL has published a course of lectures which he delivered in 1906-1907.² The field of experimental morphology, perhaps from necessity, is arbitrarily limited to what is often called developmental physiology, no reference being made to the direct influence of gravity, light, etc., on form. The author refers those who wish information on such topics to PFEFFER'S *Physiology* and his own *Organography*. Furthermore, the material presented is mainly from the higher plants, reference being made to KLEBS for similar material on the lower forms.

Especially interesting is the first chapter, which considers the mission of experimental morphology, for here the author reveals his philosophy. It is clear that GOEBEL goes about as far as KLEBS in referring plant phenomena to the influence of external factors, and he follows KLEBS in holding that the ordinary

² GOEBEL, K., *Einleitung in die experimentelle Morphologie der Pflanzen*. 8vo. pp. vi+260. figs. 135. Leipzig and Berlin: B. G. Teubner. 1908. M 8.

succession of events in the life-history of a plant is no more normal than any other succession of events that may be produced by altering the external conditions. Like KLEBS, therefore, he is obliged to discard the word normal or place it in quotation marks. To the reviewer such a viewpoint seems fundamentally sound, and it has the added attraction of throwing open to experimentation all the phenomena of development, including those that have been referred to heredity or mysterious internal causes. In harmony with this fundamental principle, illustrations are given of the omission of individual stages from a developmental series, the transposition of two such stages, and the retention of a given stage, if the conditions favorable to another are not forthcoming; even the juvenile stages may be retained through life in many instances, if the external conditions are favorable thereto. On the other hand, there are cases where juvenile forms bear flowers, the intervening stages being skipped.

The body of the book consists of four chapters, dealing respectively with the influence of external and internal conditions on leaf form, the conditions determining variations in the development of main and lateral axes, regeneration, and polarity. In all of these chapters there is a wealth of detail of the utmost value to students in experimental morphology and to those desiring a bibliography of these subjects. Not only is the literature summarized, but there are many new and suggestive experiments mentioned here for the first time. In the chapter on leaf form, heterophylly in xerophytic species of *Veronica* and in such amphibious plants as *Limnophila* plays an important part. Mutation in some ferns is definitely referred to the operation of external factors. Plants with orthotropous and plagiotropous shoots are found to belong to two categories. For example, lateral branches of the spruce (*Picea excelsa*) become orthotropous if the terminal shoot is removed, while such a reaction does not occur in *Araucaria*; the former illustrates lability, the latter stability. The same chapter contains some very interesting data concerning variation in flowers and inflorescences. Of especial significance is the transformation of *Selaginella* "flowers" into vegetative shoots by introducing the plants into moist air. Variations in flower color and form, and the relations of cleistogamous and chasmogamous flowers are here considered, much credit being properly given to KLEBS for his path-breaking work. The chapters on regeneration and polarity are most useful in gathering together the scattered literature, as well as in adding new facts.

Although the volume is denominated an introduction and not a handbook, it is indispensable not only to experimental morphologists, but to all morphologists, physiologists, and ecologists, who are at all interested in the origin and significance of plant structures. To the reviewer the book is a bit disappointing, because it seems not to get down to fundamental principles. Throughout the the work nutrition is regarded as a dominant external factor. While it is true that it is as yet impossible to resolve nutrition into its components, it is at least better to attempt to do so than to assume that nutrition is really anything definite, or even ultimate. To many of us the work will be more useful as a summary of facts than as an explanation of the conditions underlying them.—HENRY C. COWLES.